

CLAIMS

I CLAIM:

1. A process control instrument comprising:
 - 2 a circuit board having a control circuit for generating or receiving a high
frequency signal;
 - 4 an antenna including an electrical conductor; and
an intrinsic safety circuit coupling the control circuit to the antenna comprising a
6 microstrip transmission line on the circuit board electrically connecting the control circuit to the
electrical conductor, and a safety stub having a first end electrically connected to the
8 transmission line proximate the electrical conductor and a second end connected to a ground of
the control circuit.
2. The process control instrument of claim 1 wherein the safety stub
2 comprises a trace line on the circuit board.
3. The process control instrument of claim 2 wherein the second end of the
2 trace line includes conductive vias connected to the ground.

4. The process control instrument of claim 2 wherein the trace line comprises
2 a quarter wavelength trace line.

5. The process control instrument of claim 1 wherein the safety stub
2 comprises a wire element.

6. The process control instrument of claim 1 wherein the intrinsic safety
2 circuit further comprises a radial stub electrically connected to the transmission line.

7. The process control instrument of claim 1 wherein the safety stub has a
2 length selected to resonate at a select frequency of interest.

8. The process control instrument of claim 1 wherein the safety stub
2 comprises a trace line on the circuit board having a width of at least 2.0mm.

9. The process control instrument of claim 1 wherein the safety stub
2 comprises a trace line on the circuit board having a width of about 2.5mm and a length of about
10mm.

10. In a process control instrument comprising a circuit board having a radio
2 frequency circuit for generating or receiving a high frequency signal and a radar antenna
including an electrical conductor, the improvement comprising:
4 a distributed element safety circuit coupling the control circuit to the antenna
comprising a high frequency transmission line on the circuit board electrically connecting the
6 control circuit to the electrical conductor, and a safety stub having a first end electrically
connected to the transmission line proximate the electrical conductor and a second end connected
8 to a ground of the control circuit.

11. The process control instrument of claim 10 wherein the safety stub
2 comprises a trace line on the circuit board.

12. The process control instrument of claim 11 wherein the second end of the
2 trace line includes conductive vias connected to the ground.

13. The process control instrument of claim 11 wherein the trace line
2 comprises a quarter wavelength trace line.

14. The process control instrument of claim 10 wherein the safety stub
2 comprises a wire element.

15. The process control instrument of claim 10 wherein the safety circuit
2 further comprises a radial stub electrically connected to the transmission line.
16. The process control instrument of claim 10 wherein the safety stub has a
2 length selected to resonate at a select frequency of interest.
17. The process control instrument of claim 10 wherein the safety stub
2 comprises a trace line on the circuit board having a width of at least 2.0mm.
18. The process control instrument of claim 10 wherein the safety stub
2 comprises a trace line on the circuit board having a width of about 2.5mm and a length of about
10mm.

19. A process control instrument comprising:

2 a circuit board having first and second sides and a control circuit on the first side
for generating or receiving a high frequency signal;

4 an antenna including a coaxial electrical conductor having a center conductor and
a shield; and

6 an intrinsic safety circuit coupling the control circuit to the antenna comprising
the circuit board first side including a first microstrip stub electrically connected to the control
8 circuit and a ground plane proximate the first microstrip stub, the circuit board second side
including a second microstrip stub, directly underlying the first microstrip stub, electrically
10 connected to the center conductor, and a ground pad, underlying the ground plane, electrically
connected to the shield.

20. The process control instrument of claim 19 wherein the first microstrip
2 stub and the second microstrip stub are each of quarter wavelength.

21. The process control instrument of claim 19 further comprising a second
2 ground plane on the circuit board second side proximate the second microstrip stub and the
ground pad.

22. The process control instrument of claim 21 wherein spacing between the
2 second ground plane and the ground pad is at least 2.0mm.

23. The process control instrument of claim 19 wherein the ground pad is
2 configured to resonate at an operating frequency.

24. The process control instrument of claim 19 wherein the ground pad
2 comprises a microstrip line connected between opposite radial stubs.

25. A through air radar process control instrument comprising:

2 a circuit board having first and second sides and a control circuit on the first side
for generating or receiving a high frequency microwave signal;

4 an antenna including a coaxial electrical conductor having a center conductor and
a shield; and

6 an intrinsic safety circuit coupling the control circuit to the antenna comprising
the circuit board first side including a microstrip quarter wavelength first stub electrically
8 connected to the control circuit and a ground plane proximate the first stub, the circuit board
second side including a microstrip quarter wavelength second stub galvanically isolated from the
10 first stub and electrically connected to the center conductor, the second stub being positioned to
couple microwave energy from the control circuit to the antenna, and a ground pad, underlying
12 the ground plane, electrically connected to the shield.

26. The through air radar process control instrument of claim 25 further
2 comprising a second ground plane on the circuit board second side proximate the second stub
and the ground pad.

27. The through air radar process control instrument of claim 26 wherein
2 spacing between the second ground plane and the ground pad is at least 2.0mm.

28. The through air radar process control instrument of claim 25 wherein the
2 ground pad is configured to resonate at an operating frequency.

29. The through air radar process control instrument of claim 25 wherein the
2 ground pad comprises a microstrip line connected between opposite radial stubs.